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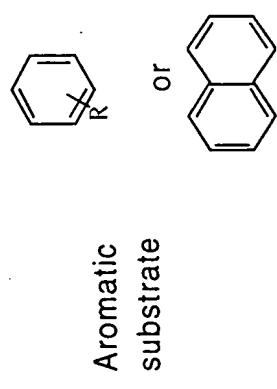
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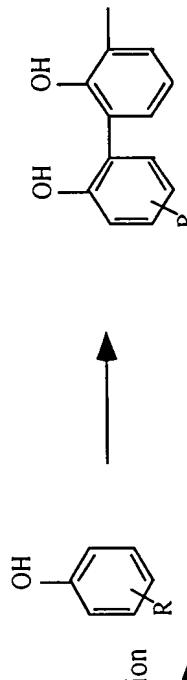
Polymerization  
(Peroxidase or laccase)

for example

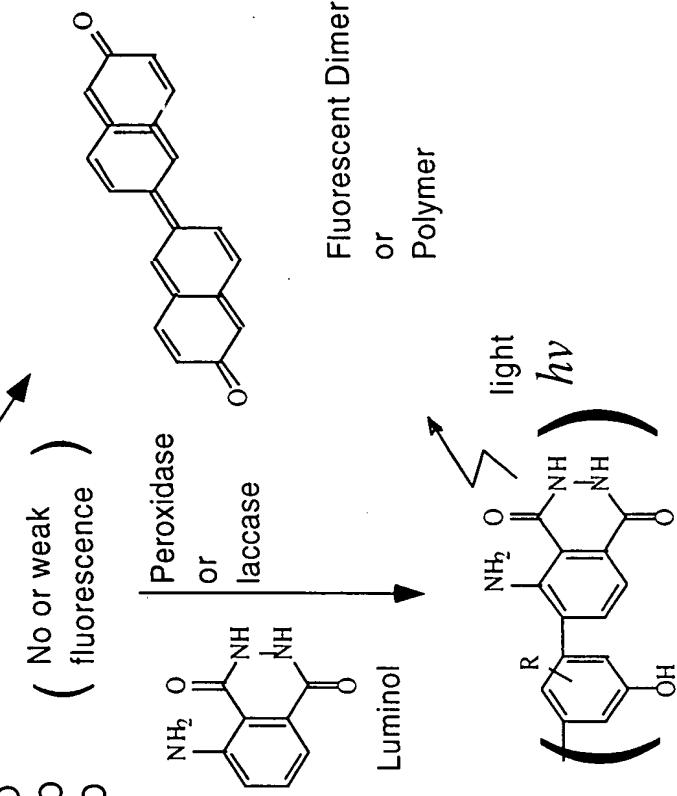


MMO  
P450  
CPO  
NDO  
TDO

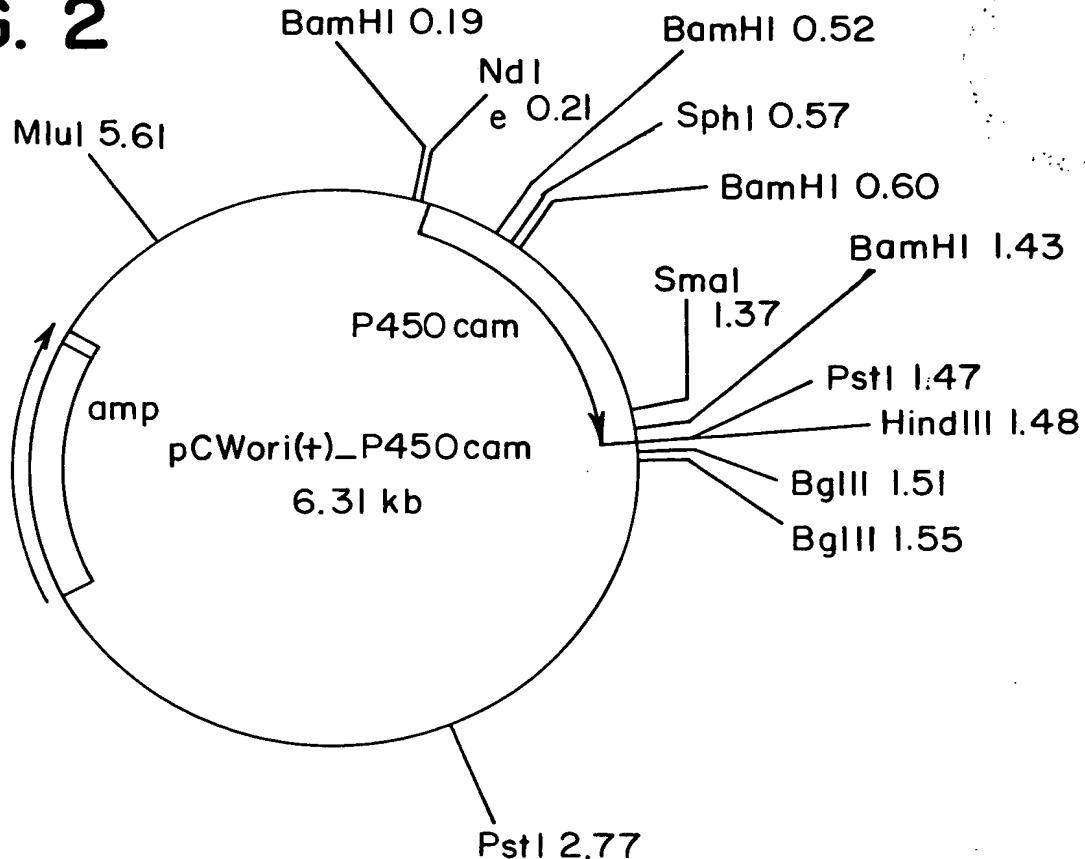
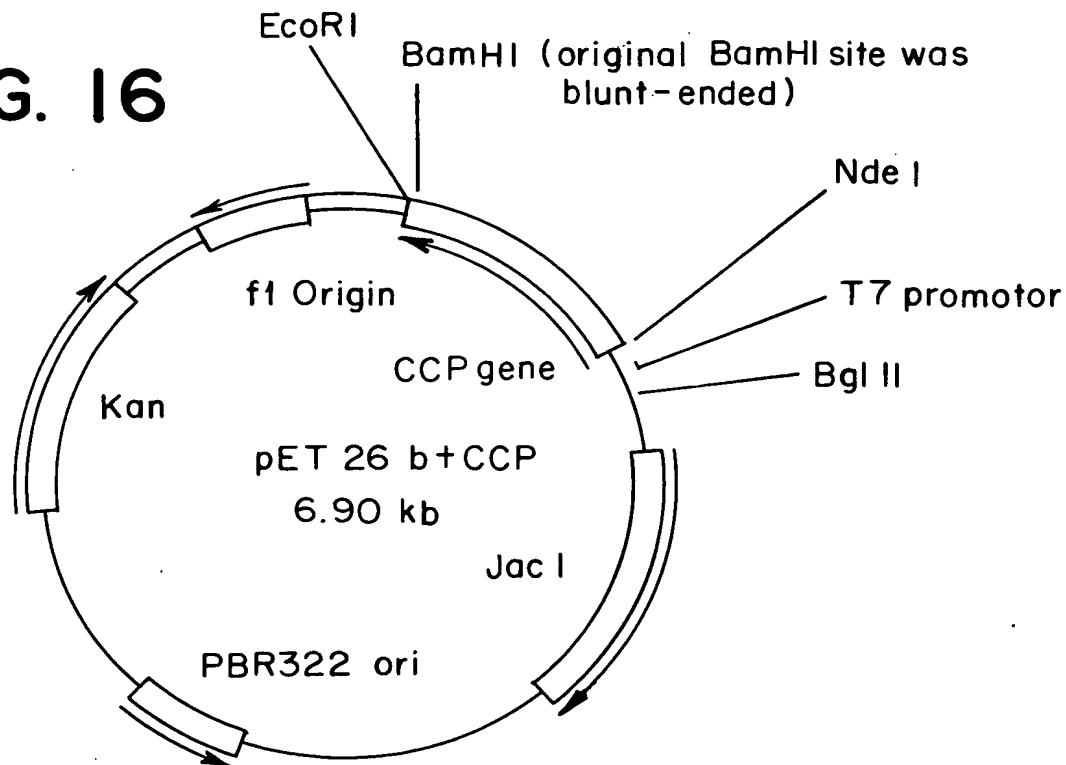
Hydroxylation



**FIG. I**



Polymers with long chemiluminescent

**FIG. 2****FIG. 16**

# FIG. 3A

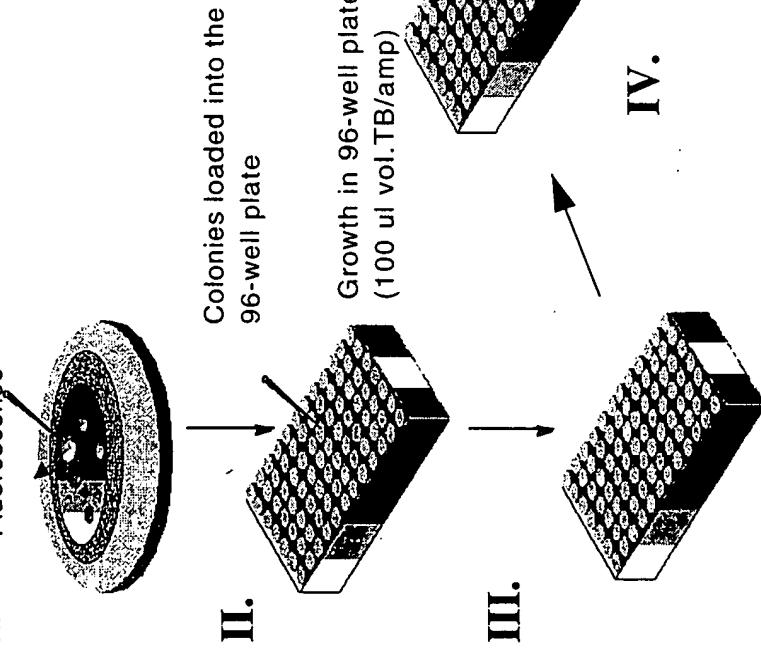
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1 CTGCAAGGATC GTTATCGCT CGCGCGATCTG ATCACCCAGC GTTTTCAT CGACGGGCC  
61 AGCAAGGCAC TTGAACTGGT CAAGGAGGA GCACTGTATCA AACCGTAT CGACTCCACT  
121 CTTAGCAA CCCGGTTCC AGGAGAACAA CAACATGAC GACTGAAACC ATACAAAGCA  
181 AOGCCAATCT TGCCCGCTTG CCACCCATG TGCCAGGGCA CCTGGTATC GACTGACCA  
241 TGTACANTCC GCGAAATCTG TCTGGCGGG TGCGAGGGC CTCGGCATG CTGCAAGAAT  
301 CAAAGTAAC GGATCTGGT TCGACTCTGCT GCAACCGGG ACACGGATC GCACTGGCG  
361 GCGAAGTAT CGGTGAGGCC TATGAGATT AACGCGACTT TTCCAGGGAG TCCCGTTCA  
421 TCCCTGTA AGCGCGGAA GCCTAGGACT TCATTCGAC CTCGAGGAT CGCGCGAGC  
481 AGCGCGAGT TGTGCGCTG GCGAACCAAG TGGTGGCAT GCCTGGGGT GATAAGCTGG  
541 AGAACCGAT CGAGGAGCTG GCCTGCTGCG TGATGAGAG CCTGCGCCG CGAGGACAGT  
601 GCAACTTCAC CGAGGACTAC GCGGAACTC TOCCGATAG CTCCTTCAG CTGCTGGAG  
661 GTCTACCGA AGAGATATC CGGCACTGA AATACTAAC GGTACAGTG ACCCGTGG  
721 ATGGCAGCAT GACCTTOGA GAGGCCAAGG AGGGGCTCTA CGACTATCTG ATACCGATCA  
781 TGGGAAACG CAGGGAGAAG CGGGAAACG AGGCTATCAG CATGGTGGC AACGGCAGG  
841 TCAATGGCG ACCGATCAC C AGTGAAGAG CGAAGGAGAT GTGTGGCTG TTACTGGTGG  
901 GGGGCGTGA TAGGTTGGT AATTCTCA GCTTCAGCAT GAGGTTCCTG GCGAAAGCC  
961 CGGAGCATCG CCAGGAGCTG ATGGAGCGTC CGAGGGAT TCCAGGGCT TGCGAGGAAC  
1021 TACTCGCG CTCTCGCTG GTTGGCGATG GGGCATCT CACCTCGAT TACGAGTTTC  
1081 ATGGCGTCA ACTGAGAA GGTGACCAAA TCTGTACCG TCGAGATGCTG TCTGGCTG  
1141 ATGAGGCGA AAAGCCCTGC CGGATGCAAG TCGACTTCAG TCGCGAAAG GTTTCACACA  
1201 CCACCTTGG CCACGGCAGC CATCTGTGCC TTGGCCAGCA CCTGGCGCG CGGAAATCA  
1261 TGTCAACCT CAAGGAATGG CTGACCAAGA TTGCTGACTT CTCCATTCGC CGGGGCGC  
1321 AGATTCAGCA CAAGAGCGGC ATGTCAGCG CGTGCAGGC ACTCCCTCTG GTCCTGGGATC  
1381 CGGCGACTAC CAAGGGGTA TA

## FIG. 3B

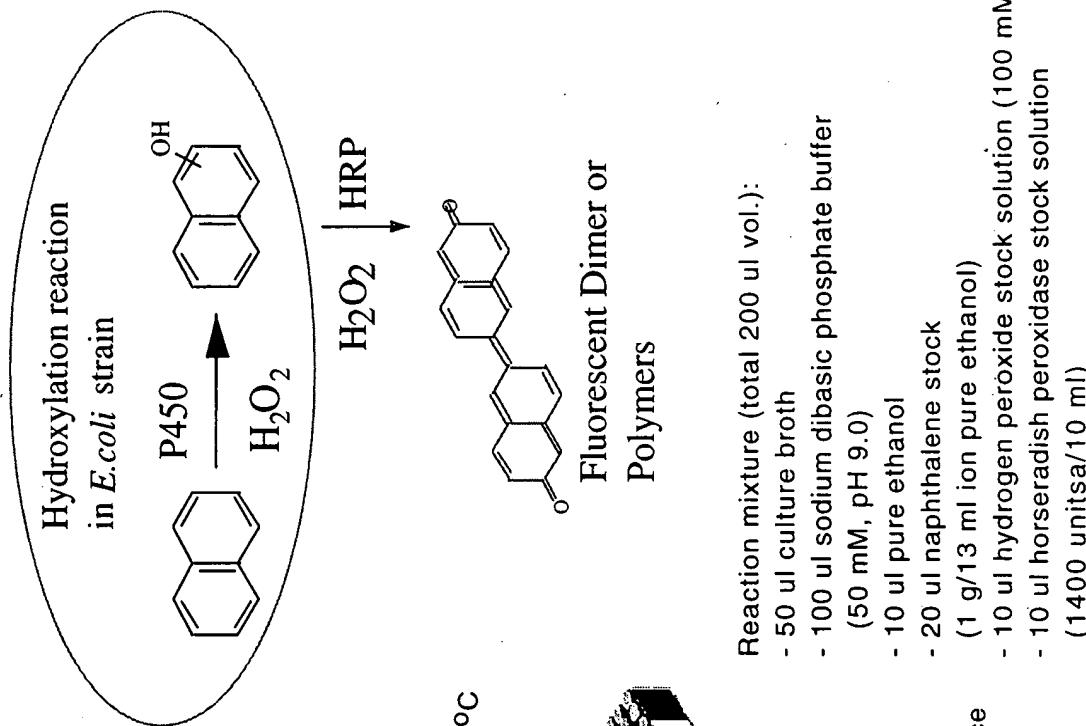
THR THR GLU THR ILE GLN SER ASN ALA ASN LEU ALA PRO  
LEU PRO PRO HIS VAL PRO GLU HIS LEU VAL PHE ASP PHE  
ASP MET TYR ASN PRO SER ASN LEU SER ALA GLY VAL GLN  
GLU ALA TRP ALA VAL LEU GLN GLU SER ASN VAL PRO ASP  
LEU VAL TRP THR ARG CYS ASN GLY GLY HIS TRP ILE ALA  
THR ARG GLY GLN LEU ILE ARG GLU ALA TYR GLU ASP TYR  
ARG HIS PHE SER SER GLU CYS PRO PHE ILE PRO ARG GLU  
ALA GLY GLU ALA TYR ASP PHE ILE PRO THR SER MET ASP  
PRO PRO GLU GLN ARG GLN PHE ARG ALA LEU ALA ASN GLN  
VAL VAL GLY MET PRO VAL VAL ASP LYS LEU GLU ASN ARG  
ILE GLN GLU LEU ALA CYS SER LEU ILE GLU SER LEU ARG  
PRO GLN GLY GLN CYS ASN PHE THR GLU ASP TYR ALA GLU  
PRO PHE PRO ILE ARG ILE PHE MET LEU LEU ALA GLY LEU  
PRO GLU GLU ASP ILE PRO HIS LEU LYS TYR LEU THR ASP  
GLN MET THR ARG PRO ASP GLY SER MET THR PHE ALA GLU  
ALA LYS GLU ALA LEU TYR ASP TYR LEU ILE PRO ILE ILE  
GLU GLN ARG ARG GLN LYS PRO GLY THR ASP ALA ILE SER  
ILE VAL ALA ASN GLY GLN VAL ASN GLY ARG PRO ILE THR  
SER ASP GLU ALA LYS ARG MET CYS GLY LEU LEU LEU VAL  
GLY GLY LEU ASP THR VAL VAL ASN PHE LEU SER PHE SER  
MET GLU PHE LEU ALA LYS SER PRO GLU HIS ARG GLN GLU  
LEU ILE GLU ARG PRO GLU ARG ILE PRO ALA ALA CYS GLU  
GLU LEU LEU ARG ARG PHE SER LEU VAL ALA ASP GLY ARG  
ILE LEU THR SER ASP TYR GLU PHE HIS GLY VAL GLN LEU  
LYS LYS GLY ASP GLN ILE LEU LEU PRO GLN MET LEU SER  
GLY LEU ASP GLU ARG GLU ASN ALA CYS PRO MET HIS VAL  
ASP PHE SER ARG GLN LYS VAL SER HIS THR THR PHE GLY  
HIS GLY SER HIS LEU CYS LEU GLY GLN HIS LEU ALA ARG  
ARG GLU ILE ILE VAL THR LEU LYS GLU TRP LEU THR ARG  
ILE PRO ASP PHE SER ILE ALA PRO GLY ALA GLN ILE GLN  
HIS LYS SER GLY ILE VAL SER GLY VAL GLN ALA LEU PRO  
LEU VAL TRP ASP PRO ALA THR THR LYS ALA VAL

**FIG. 4A**



P450cam protein expression by adding 0.5-1 mM IPTG  
and 1 mM thiamine, 0.5 - 1.3 mM delta-ALA, 0.5 ml trace  
element stock/10ml medium (total : 120 ul. vol)  
Induction time : 24 hours  
Induction temperature : 30 °C

**FIG. 4B**



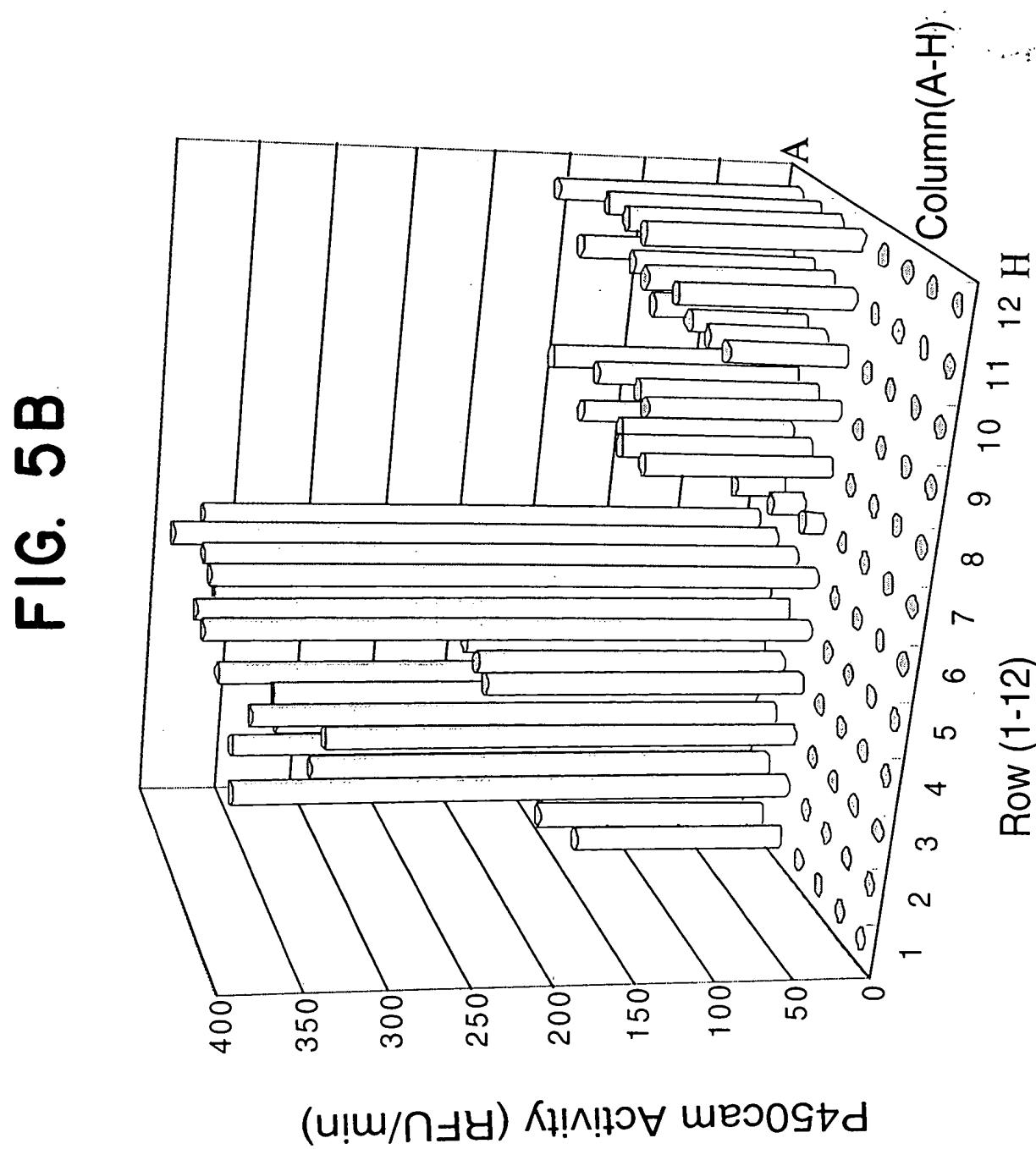
# FIG. 5A

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	1	2	3	4	5	6	7	8	9	10	11	12
A	2x			2x			2x			2x		
B	2x			2x	pCWori + P450cam		2x			2x		
C	2x			2x			2x			2x		
D	2x			2x			2x			2x		
E	2x			2x			2x			2x		
F	2x			2x	XL-10 <i>E.coli</i> strain		2x			2x		
G	2x			2x			2x			2x		
H	2x			2x			2x			2x		

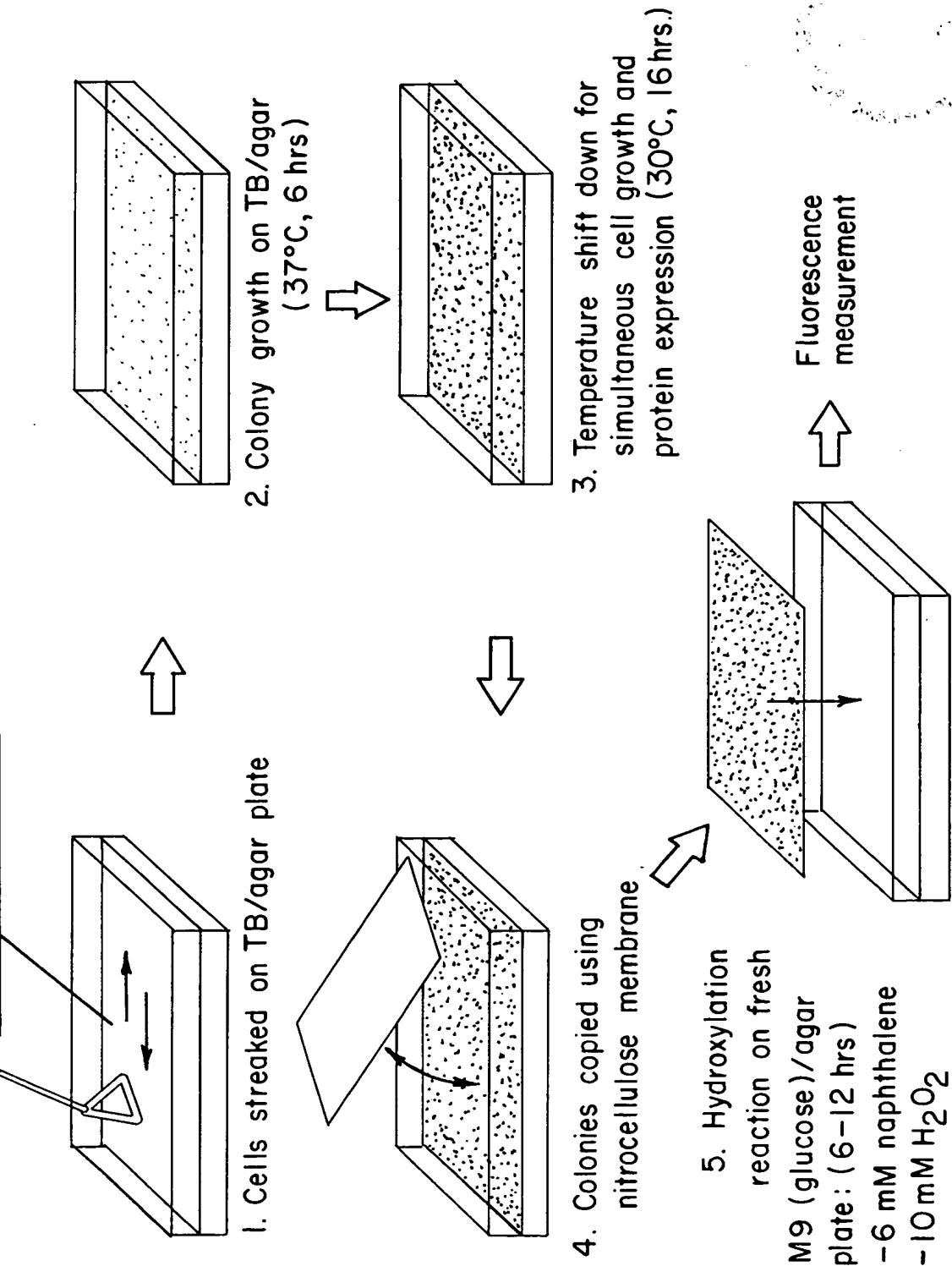
\* 2x : 200 ul cultivation volume, others : 100 ul cultivation volume

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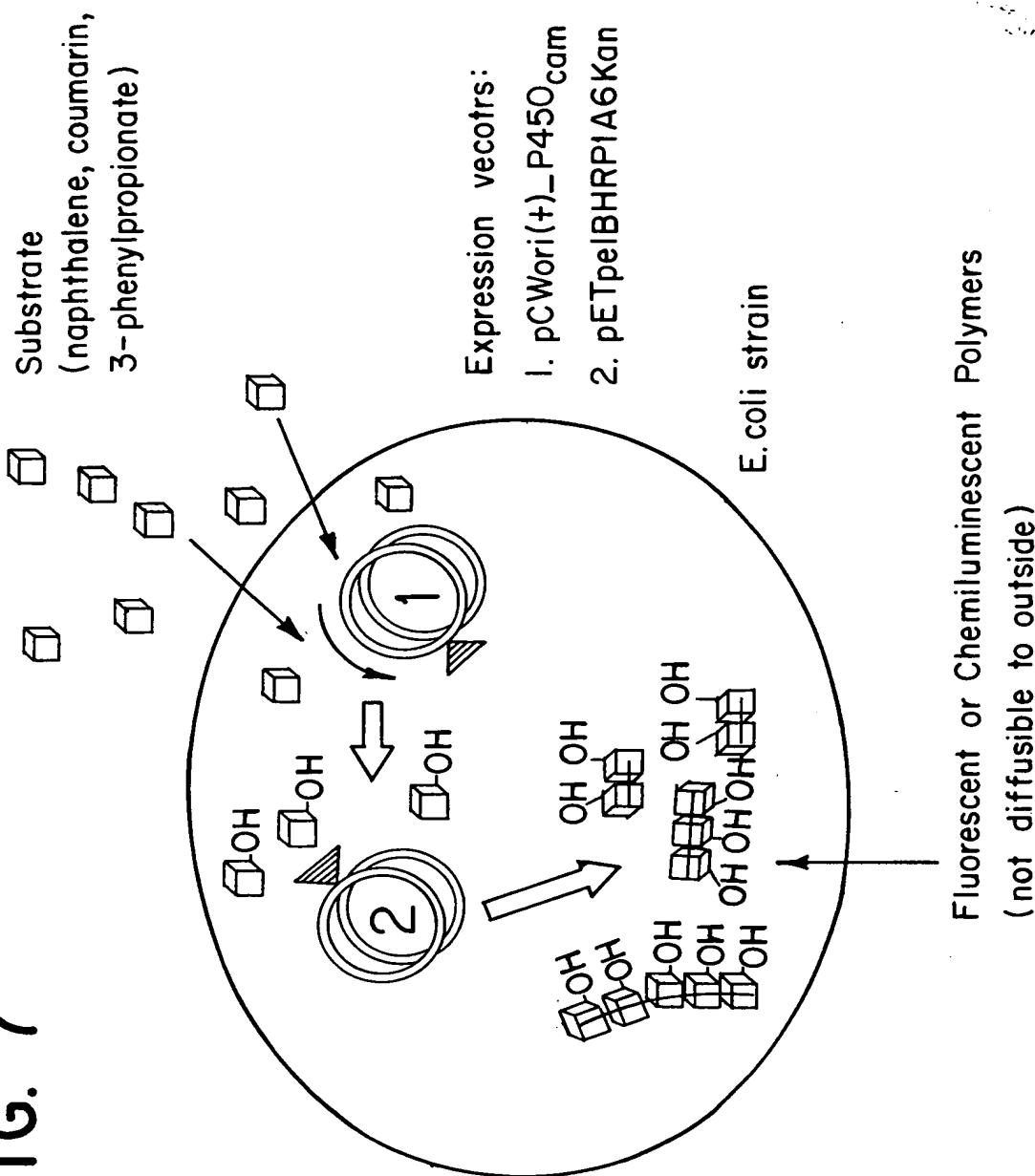
E.coli transformed with  
pCWori (+) - P45Ocam &  
pETpEI BHRP1A6Kan

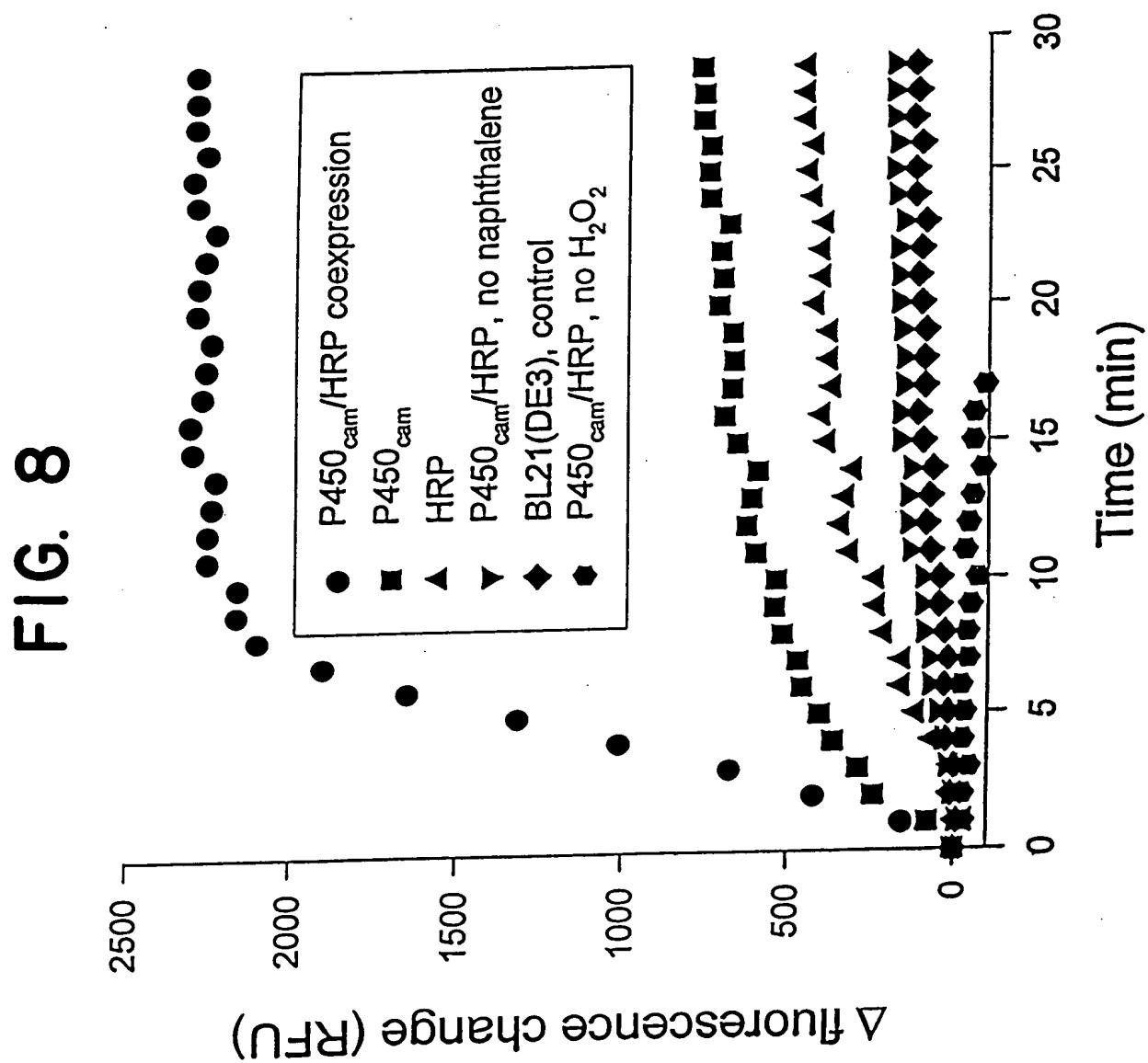
## FIG. 6



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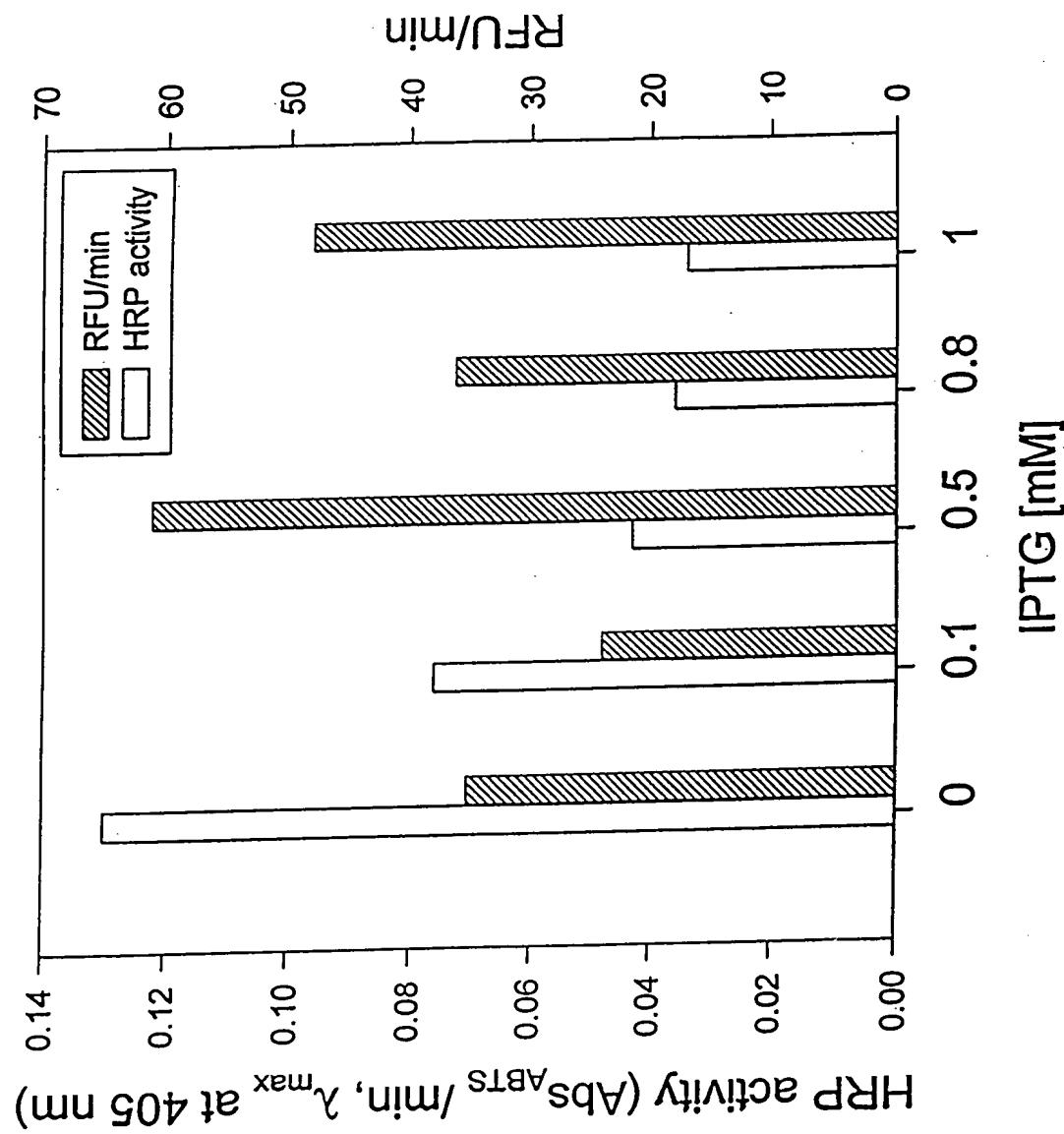
FIG. 7





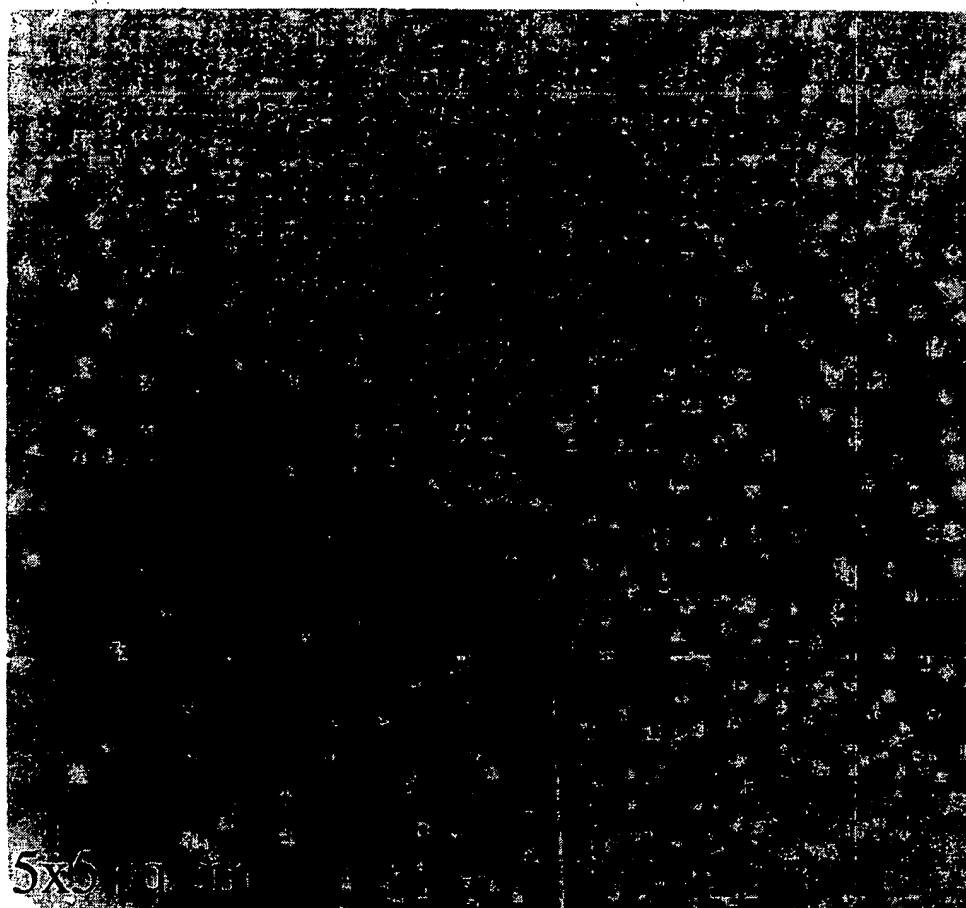
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FIG. 9

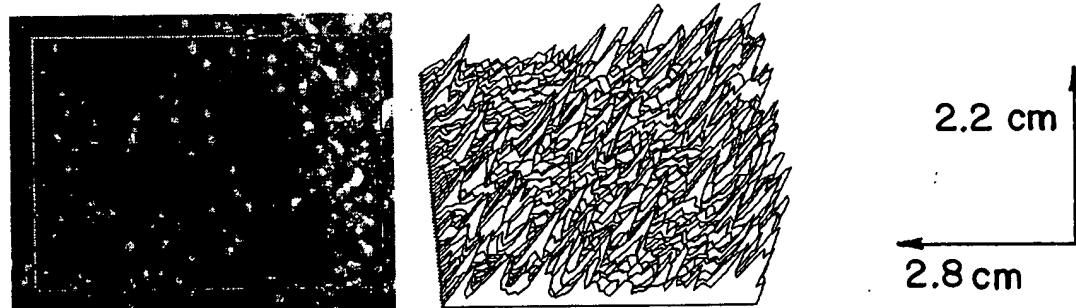


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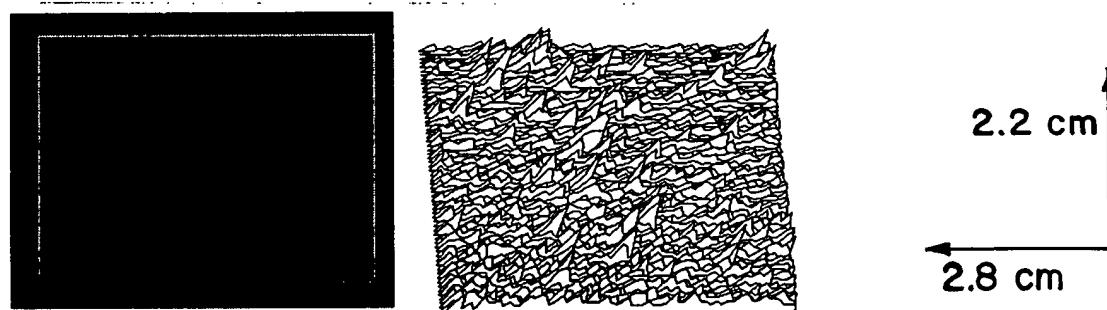
**FIG. 10**

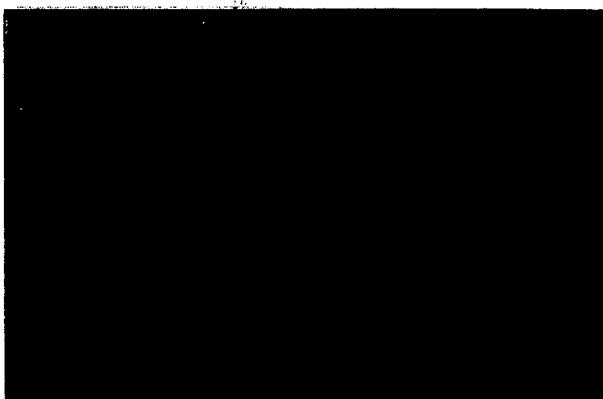


**FIG. 12A**

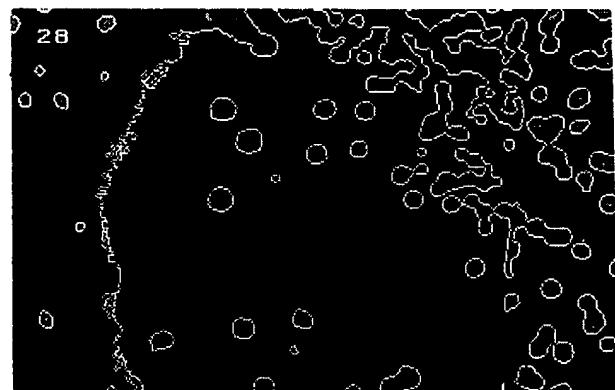


**FIG. 12B**

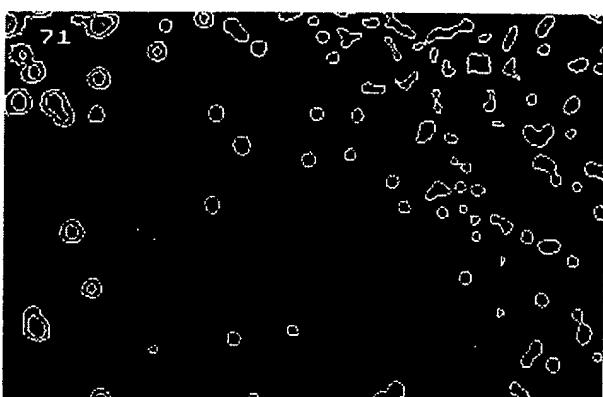




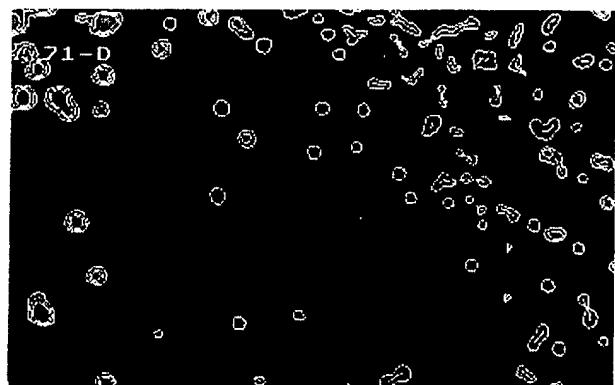
**FIG. II A**



**FIG. II B**



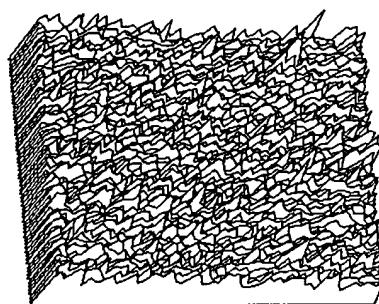
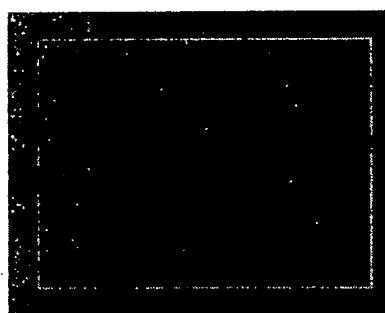
**FIG. II C**



**FIG. II D**

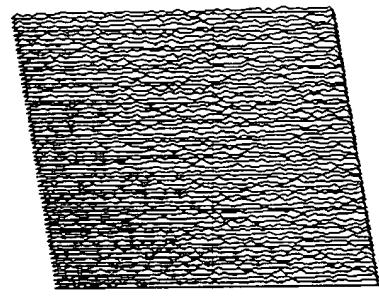
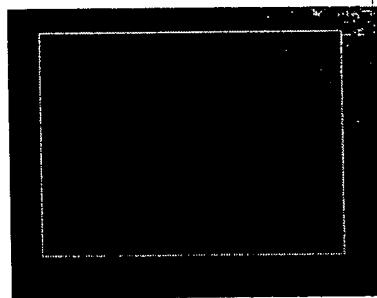
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**FIG. I2C**



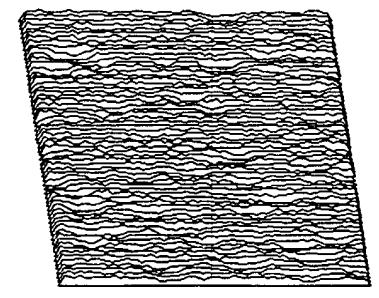
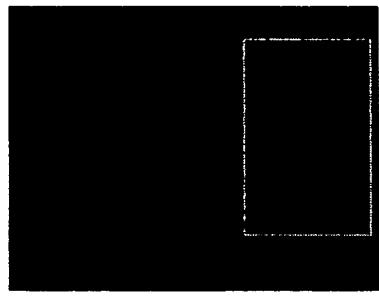
2.2 cm  
2.8 cm

**FIG. I2D**



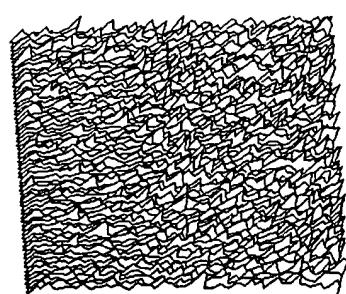
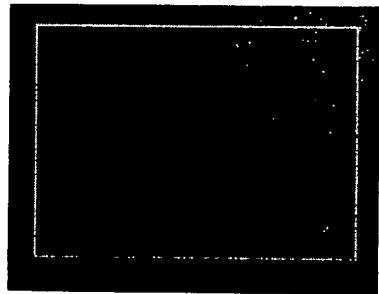
2.2 cm  
2.8 cm

**FIG. I2E**



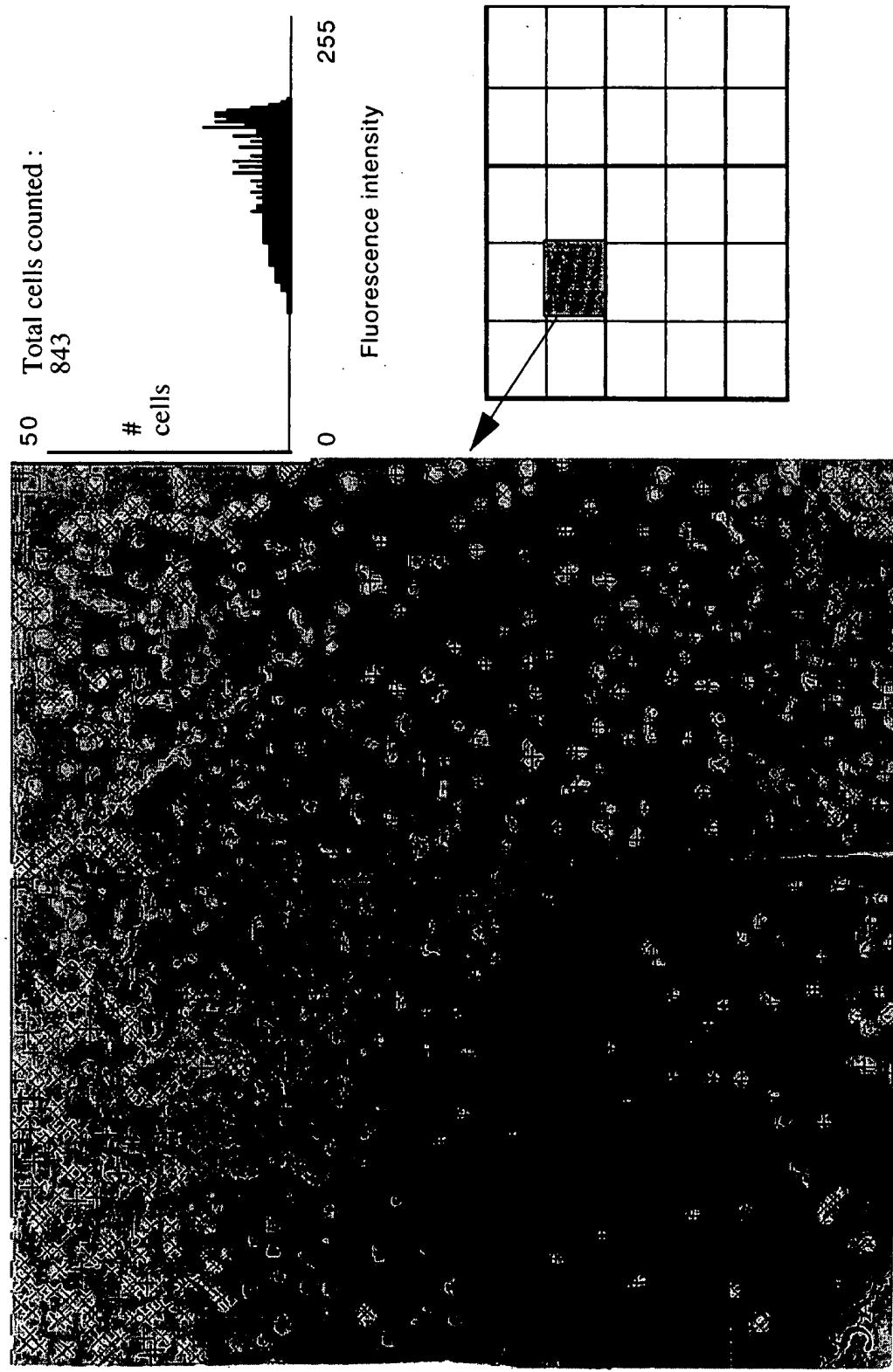
2.2 cm  
2.8 cm

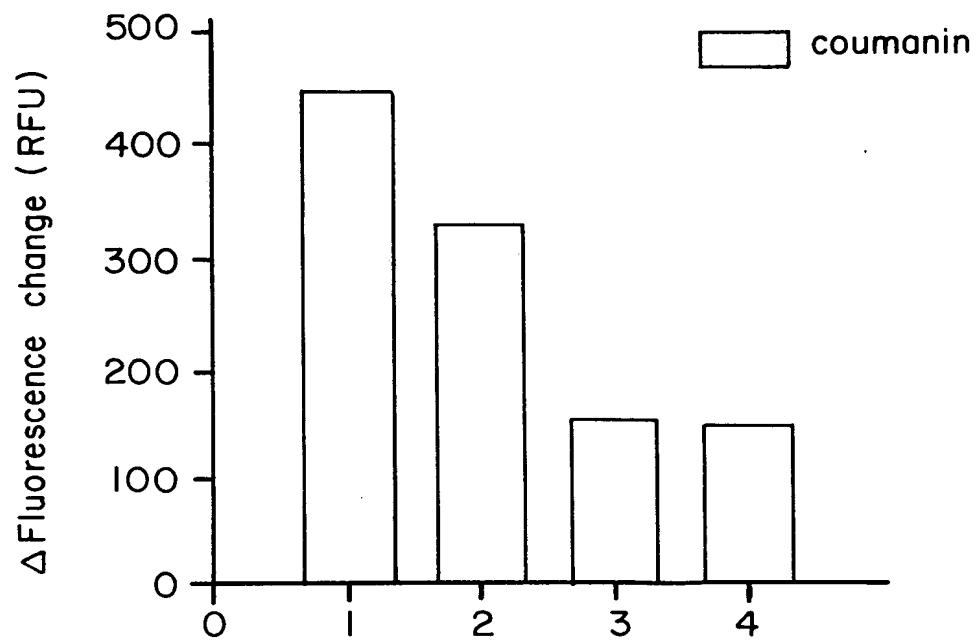
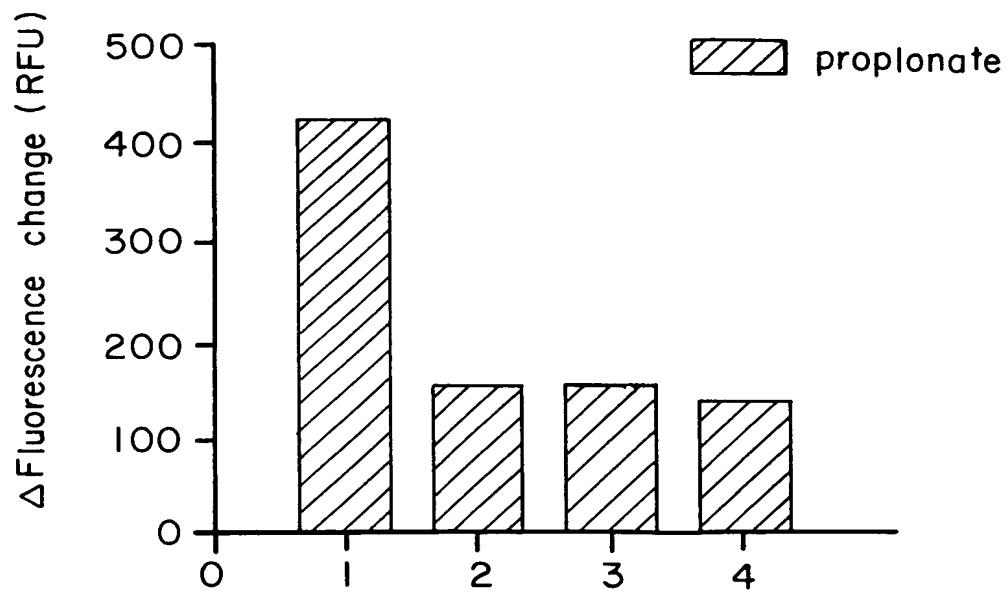
**FIG. I2F**



2.2 cm  
2.8 cm

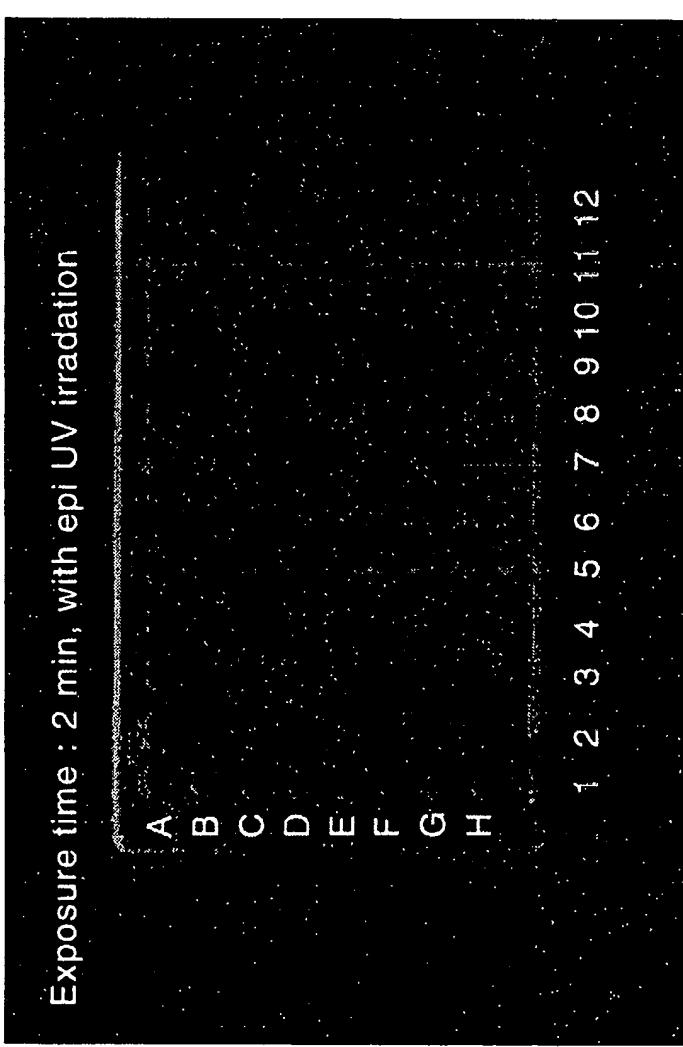
**FIG. 13**



**FIG. 14A****FIG. 14B**

# FIG. 15A

Exposure time : 2 min, with epi UV irradiation



Row:

E: 60uM luminol+0.5 mM PPP  
F: 120 uM luminol+0.5 mM PPP  
G: 60 uM luminol  
H: 120 uM luminol

Column:

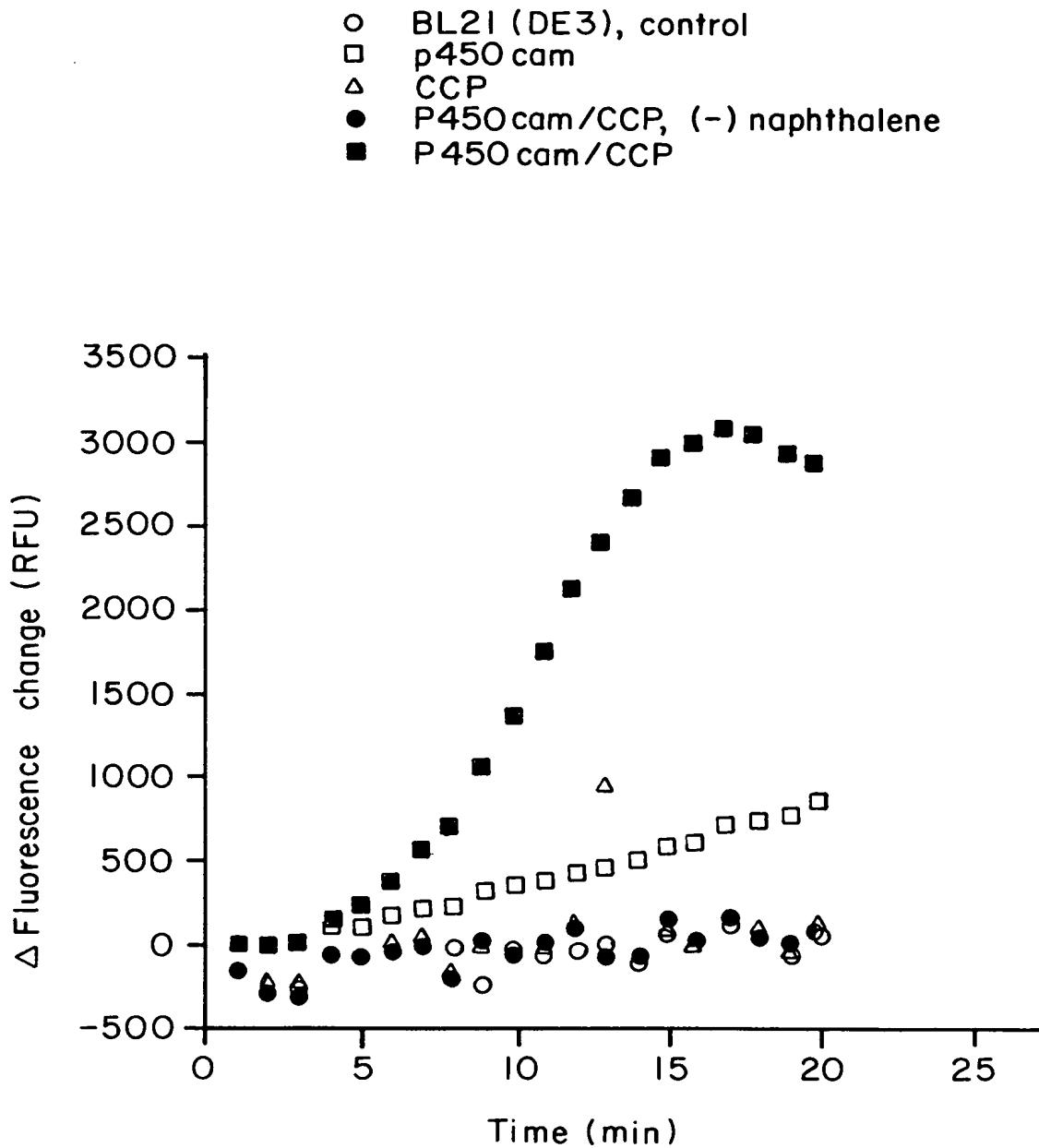
4: P450cam/HRP1A6 in  
BL21 (DE3)  
5: P450cam in BL21 (DE3)  
6: HRP1A6 in BL21 (DE3)  
7: Host strain, BL21 (DE3)

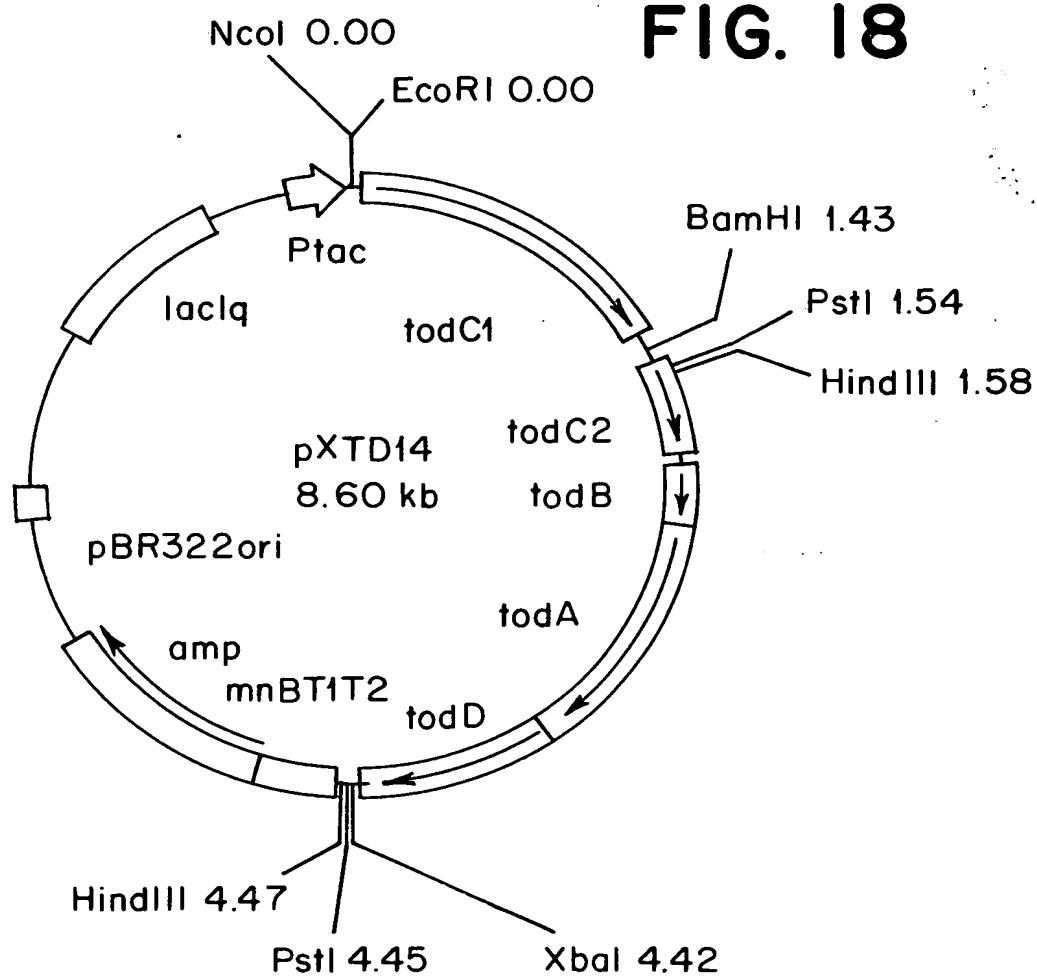
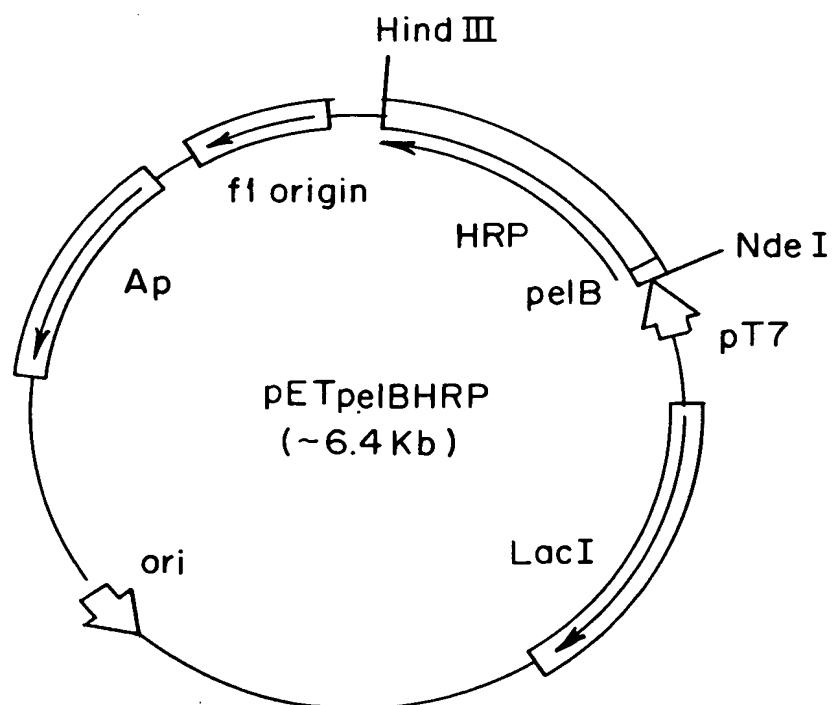
# FIG. 15B

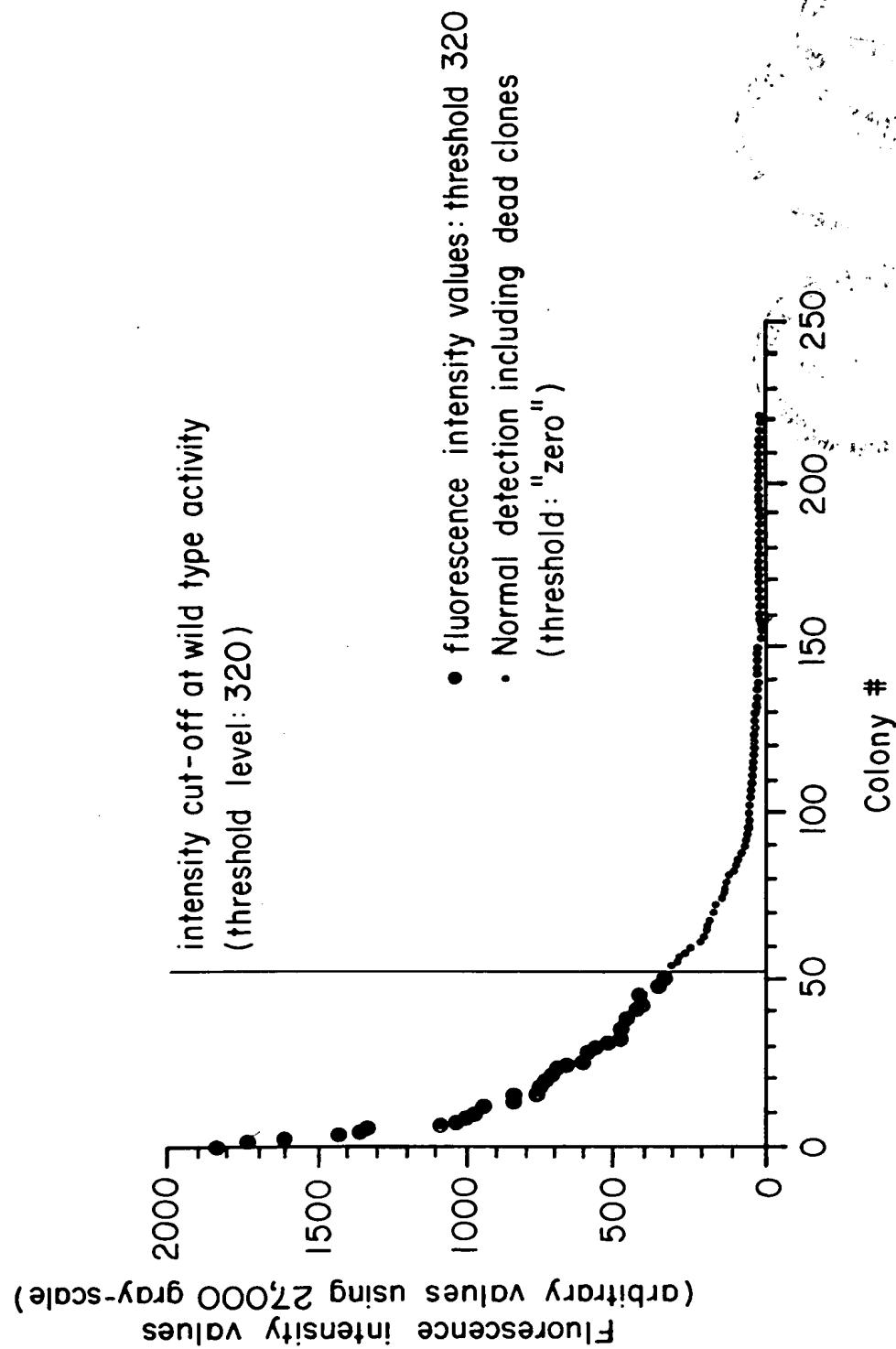


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FIG. 17

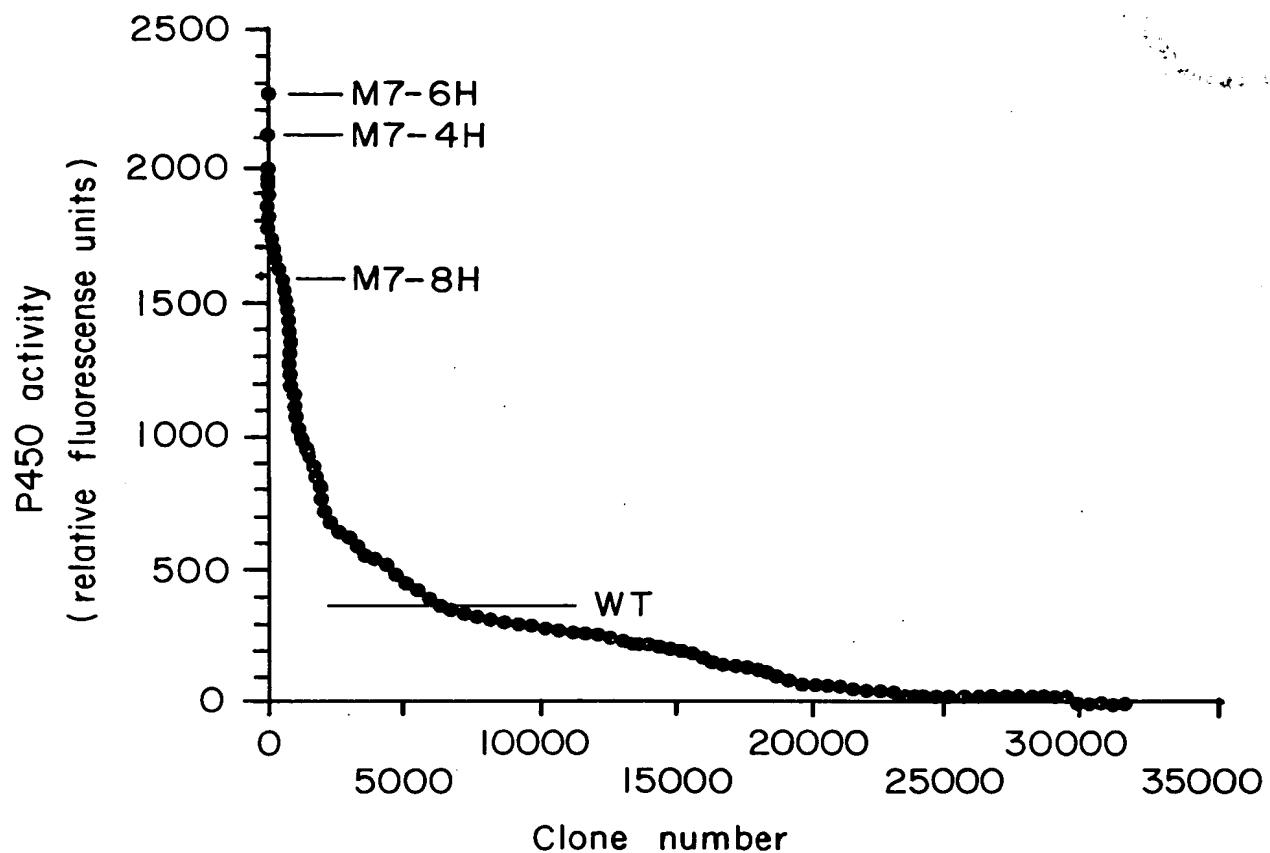


**FIG. 18****FIG. 21**

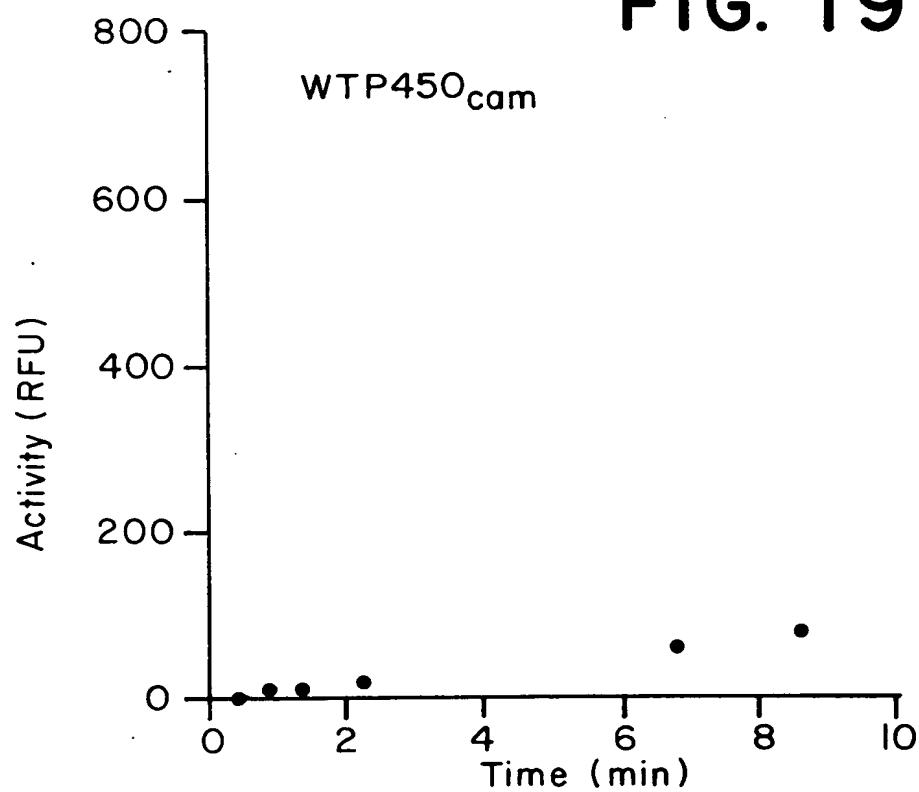
**FIG. 19A**

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**FIG. 19B**

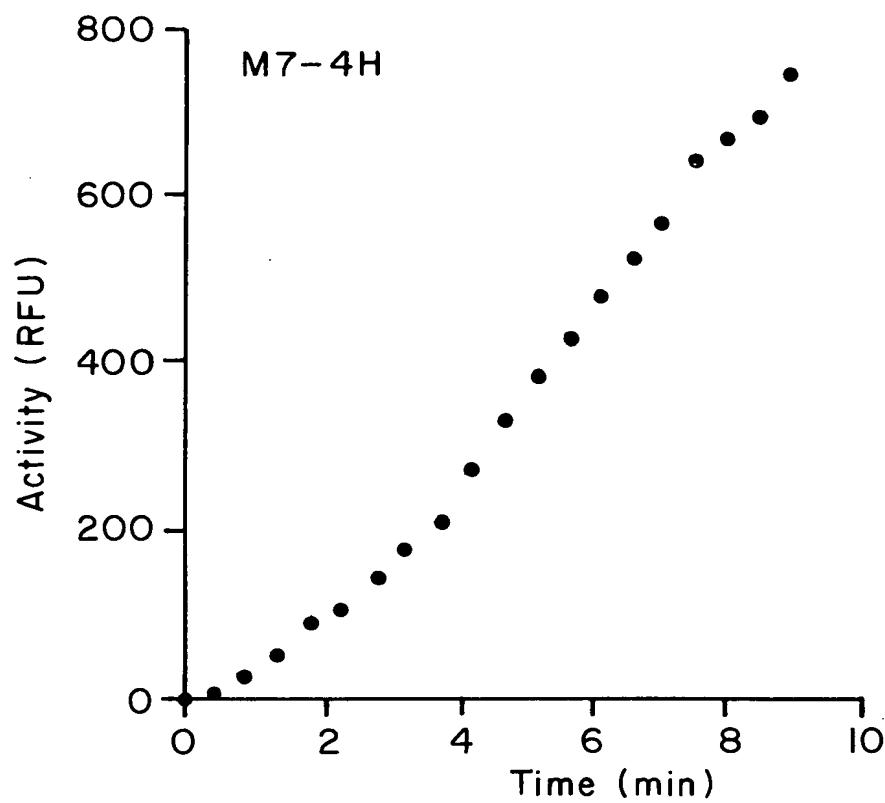


**FIG. 19C**



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**FIG. 19 D**



**FIG. 19 E**

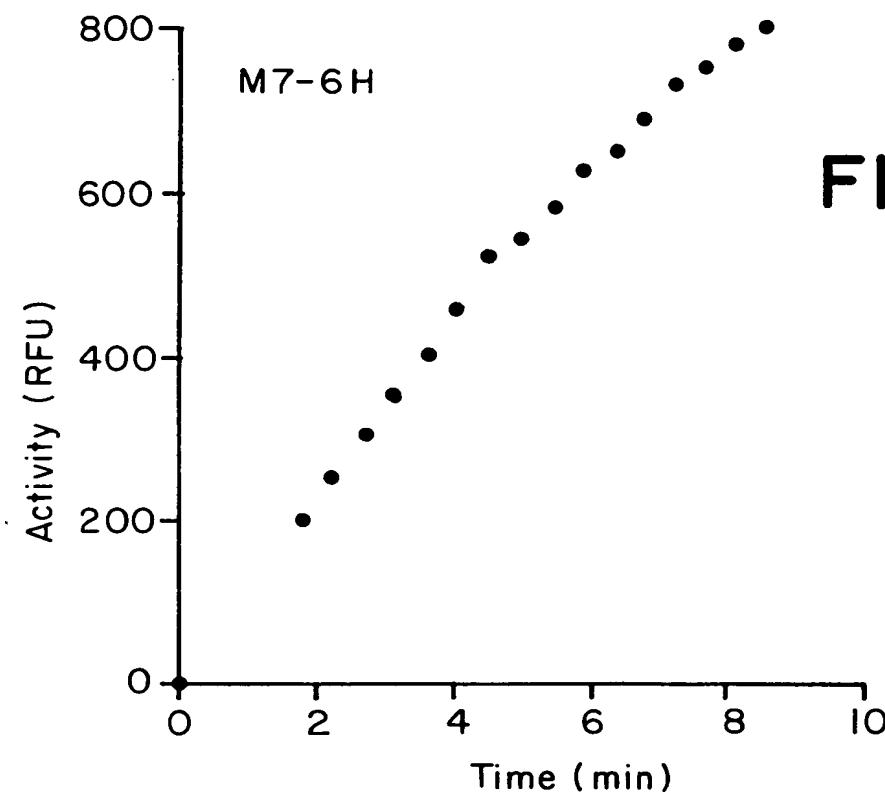


FIG. 19 F

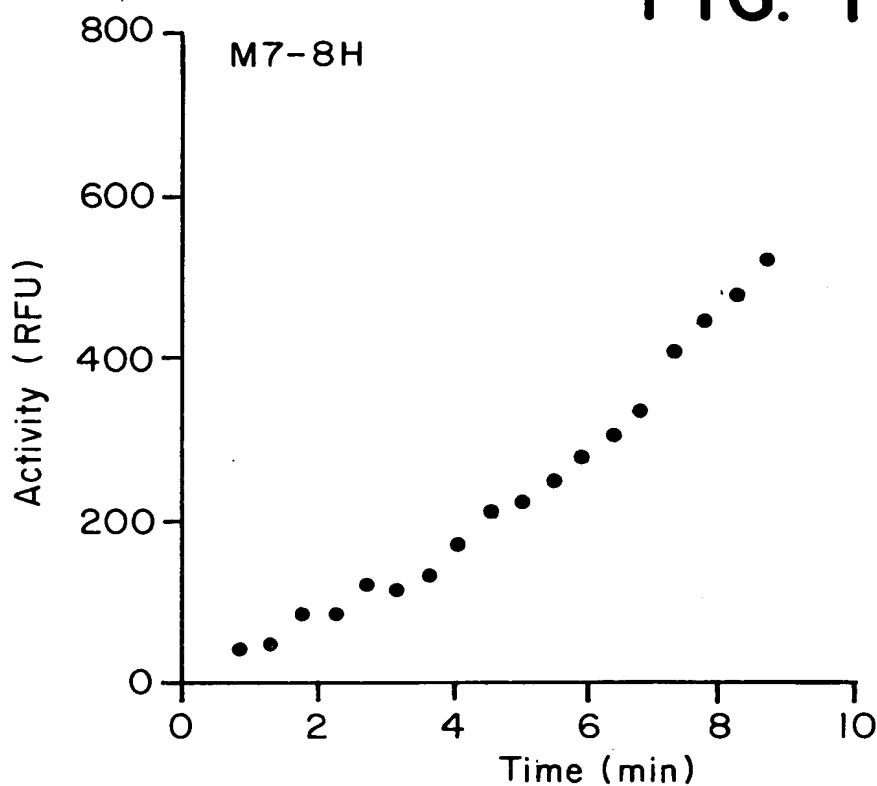
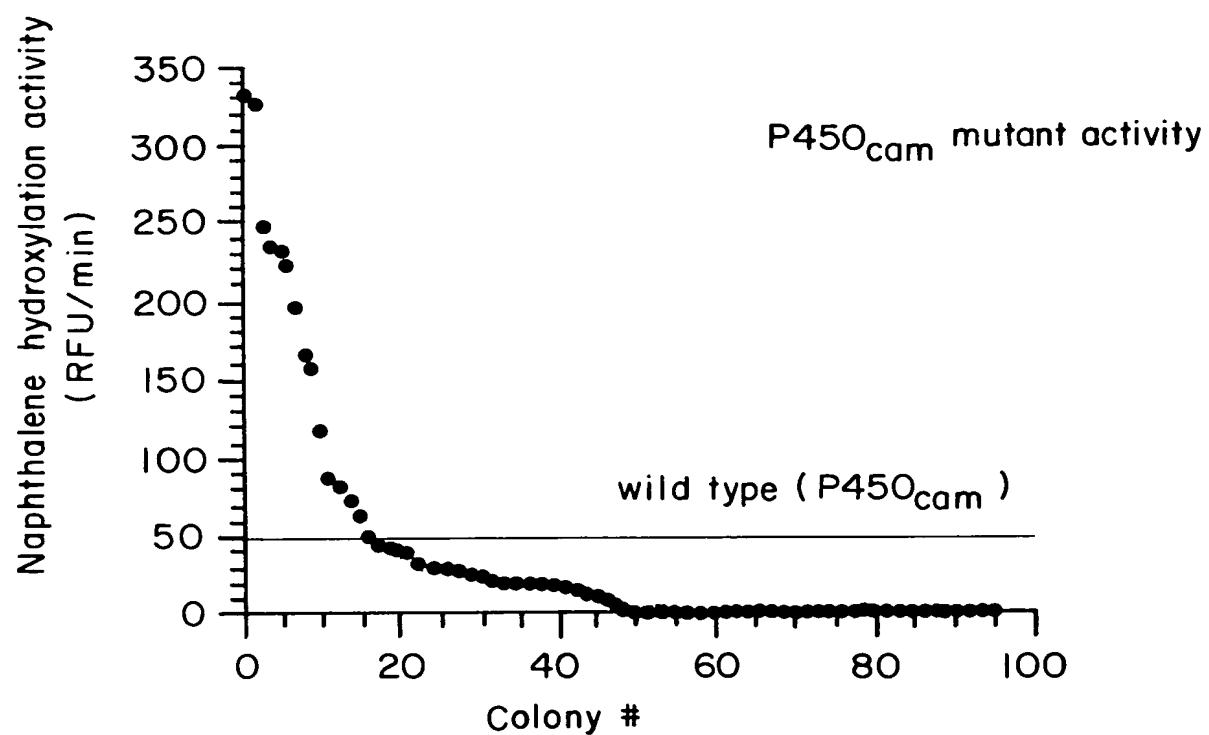


FIG. 20



# FIG. 22

ATG AAA TAC CCT ATT G CCT ACG GCA GCC GCT GGA ATT TTA CTC GCT GCC CAA CCA GCC ATG GCC  
Met Lys Tyr Leu Leu Pro Thr Ala Ala Ala Gly Leu Leu Leu Ala Ala Glu Pro Ala Met Ala

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# FIG. 23A

10            20            30            40            50            60  
ATGCAGTTAACCCCTACATTCTACGGACAAATAGCTGTGCCAACGTTCCAACATCGTTGCC

M Q L T P T F Y D N S C P N V S N I V R

70            80            90            100          110          120  
GACACAATCGTCAACGAGCTCAGATCCCGATCCCAGGATCGCTGCTCAATTACGTCTG

D T I V N E L R S D P R I A A S I L R L

130          140          150          160          170          180  
CACTTCCATGACTGCTTCGTTGTAATGGTTGCGACGCTAGCATATTACTGGACAACACCAC

H F H D C F V N G C D A S I L L D N T T

190          200          210          220          230          240  
AGTTTCCGGCACTGAAAGGATGCTTGGAAACGCTAACAGGGCCAGGGCTTTCAGTG

S F R T E K D A F G N A N S A R G F P V

A —————— A

# FIG. 23B

A ————— A

250      260      270      280      290      300  
ATCGATCCATGAGGCTGCCGTTCAGTCAGAACAGTCAGTGTGCAGAC  
I D R M K A A V E S A C P R T V S C A D

310      320      330      340      350      360  
CTGGCTGACTATAAGCTGGCAACAGAGCGTGACTCTTGAGGGGACCGTCCCTGGAGAGTC  
L L T I A A Q Q S V T L A G P S W R V

370      380      390      400      410      420  
CGGCTCGGTGACGTGACTCCCTACAGGCATTCCCTAGATCTGGCCAACGCCAACTTGCCCT  
P L G R R D S L Q A F L D L A N A N L P

430      440      450      460      470      480  
GCTCCATTCTCACCCCTGCCCAAGCTGAAGCATAGCTTAGAAAACGTTGGGTCTGAATCGC  
A P F F T L P Q L K D S F R N V G L N R

490      500      510      520      530      540  
TCGAGTGACCTTGGCTCTGGTCCGGAGGACACACATTGGAAAGAACCAAGTGTAGGTTTC  
S S D L V A L S G G H T F G K N Q C R F

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B ————— B

# FIG. 23 C

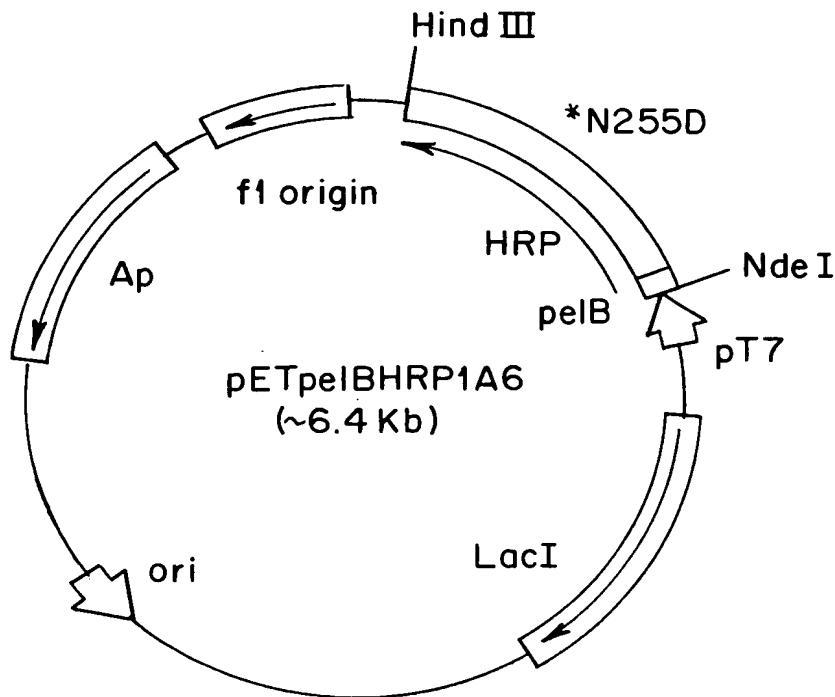
B — — — — — B

550        560        570        580        590        600  
ATCAGGATAGGCTTACAATTCAACTGGCACACTGGTTACCTGACCCACGGCTGAACACT  
I   M   D   R   L   Y   N   F   S   N   T   G   L   P   D   P   T   L   N   T  
  
610        620        630        640        650        660  
ACGTATCTCCAGACACTGAGGGCTTGCGCCCACTGAATGGCAACCTCAGTGCACTAGTG  
T   Y   L   Q   T   L   R   G   L   C   P   L   N   G   N   L   S   A   L   V  
  
670        680        690        700        710        720  
GACTTGTATCTGGGACCCCACCCATCTCGATAAACGTAAGTACTATGTGAATCTAGGGAG  
D   F   D   L   R   T   P   T   I   F   D   N   K   Y   Y   V   N   L   E   E  
  
730        740        750        760        770        780  
CAGAAAGGCCCTGATACAGGTGATCAAGAACGTTAGCAACTGTTAGCCAGTCCAGACGCCACTGACACC  
Q   K   G   L   I   Q   S   D   Q   E   L   F   S   S   P   D   A   T   D   T  
  
790        800        810        820        830        840  
ATCCCCACTGGTGAAGGTTTGCTTAACCTCAAAACCTCTCTTAAACGCCCTTCGTGCAA  
I   P   L   V   R   S   F   A   N   S   T   Q   T   F   F   N   A   F   V   E  
  
850        860        870        880        890        900  
GCCATGGACCGTATGGGTAAACATTACCCCTCTGACGGGTACCCAAGGCCAGATTGCTCTG  
A   M   D   R   M   G   N   I   T   P   L   T   G   T   Q   G   Q   I   R   L  
  
910        920        930  
AACTGGCAGAGTGGGTCAACAGCAACTCT  
N   C   R   V   V   N   S   N   S

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**FIG. 24**



**FIG. 25**

